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## **EFFECTIVENESS OF THE PUBLIC HEALTH MEASURES TO PREVENT THE SPREAD OF COVID-19**

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**Abstract:** COVID-19 which has become a global pandemic, recently, has spread to hundreds of countries and territories. This pandemic spreads rapidly through human transmission. In order to reduce the spread of COVID-19, the government emerged several policies. Numerous public health measures can be implemented to counter the risk of an emerging outbreak with pandemic potential. Meanwhile, Jakarta and West Java are the regions with the most confirmed cases in Indonesia, the government announced Large-Scale Social Restrictions (PSBB) policy in both provinces. Many researchers conducted forecasting methods for modeling or predict the further number of cases of this pandemic. Forecasting is slightly hard because of those interventions. In this study, we involved some of neural network forecasting methods, including Multi-Layer Perceptron, Neural Network Auto-Regressive, and Extreme Learning Machine meanwhile neural networks become well-known at this time for forecasting the number of active, confirmed, recovered, death, and daily new cases in Jakarta and West Java. These methods are undertaking automatically without considering any factors that will be impacted the result as the reason that we assumed those factors have pursued the pattern of each case. The best model for all of the cases is the MLP (10,10) model. This intervention carried out by the government, namely PSBB, proved effective in reducing the spread of this pandemic

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in Jakarta and West Java. This can be seen from the results of the daily new cases which show a downward trend for both although still fluctuating.

**Keywords:** COVID-19; Indonesia; public health measures; neural network.

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## 1. INTRODUCTION

Coronavirus is a family of viruses that will cause respiratory infections in humans, starting from ordinary cold to more serious conditions, for instance, Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS). The most recent kind of coronavirus that causes COVID-19 is SARS-CoV-2 [1]. The symptoms of COVID-19 ranged from gentle to severe illnesses. The symptoms of loss of taste or smell, sore throat, headache, cough, fever, muscle pain, repeated shaking due to cold, and problem respiratory [2].

COVID-19 spreads through direct or indirect contact, drop spray for short-range transmission, and air transmission. There are two ways in order to diminish the danger of infection or the spread of COVID-19. First, clean your hands frequently associated with an alcohol-based hand, or wash your hands with soap and water to kill viruses that will get on your hands. Second, keep a distance of a minimum of one meter to inhibit small droplets which will contain the virus from breathing in once someone coughs, sneezes, or talks. Crowded places should be avoided [3].

Stringent public health procedures and the lack of active care and vaccines are demanding to qualify the rule and requirement in facing an epidemic. The limitation on the activities succeed by the Chinese authorities since the country has the highest cases, including travel restrictions, quarantine, and self-isolation, has significantly reduced the effective reproduction number of COVID-19 [4]. However, these policies may not be employed effectively in other contexts though. Adjustments and modifications in various aspects are necessary in order to implement particular restrictive measures in certain countries [5].

In Indonesia, the first case was reported in Depok, West Java on March 2, 2020, and 1,606

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people were infected with 3,518 recovered cases, and 1,043 deaths were reported on May 14, 2020. This outbreak has spread to all provinces in Indonesia. Most of the confirmed cases are on the island of Java, where DKI Jakarta is the largest contributor to this outbreak [6]. The first case was confirmed after diagnosis was made with two women who contacted a Japanese man from Malaysia who had been confirmed as COVID-19 days earlier [7]. Since then, the number of cases of COVID 19 in Indonesia has increased rapidly. The highest increase in COVID-19 in Indonesia was on May 13, 2020, with 689 new cases and 21 new deaths [6].

It has been confirmed that the spread of COVID-19 via humans [8], so that human mobility is also an important factor in the spread of this outbreak. Various public health measures can be implemented to counter the risk of outbreaks of potential pandemics [9]. Measures to reduce spread in general can be divided into two main categories: the first is aimed at protecting border areas, including travel restrictions and border controls, while the second is aimed at combating the spread of the virus locally, including increasing epidemiological surveys and surveillance, contacts tracking, and closed schools, although the effectiveness of these steps is still under discussion [10].

Since the COVID-19 vaccine has not yet been discovered, the spread of the virus can be prevented by breaking the transmission chain. The government has announced several steps to reduce the spread of COVID-19. One way to break the chain of transmission is to use social distancing. The Indonesian government has adopted a social or physical distance policy to reduce the spread of this outbreak. It is hoped that not every community will be infected or contagious by not contacting anyone, with the purpose of the rate of spread can decrease or at least be kept steady. On the contrary, the community has not properly employed this rule. In some areas, such as Jakarta and West Java, as Figure 1 shows, the number of new daily cases is quite high. For this reason, the Indonesian government has issued a large scale area restrictions (Pembatasan Wilayah Berskala Besar: PSBB) directive based on the 2018 Health Quarantine Constitution.

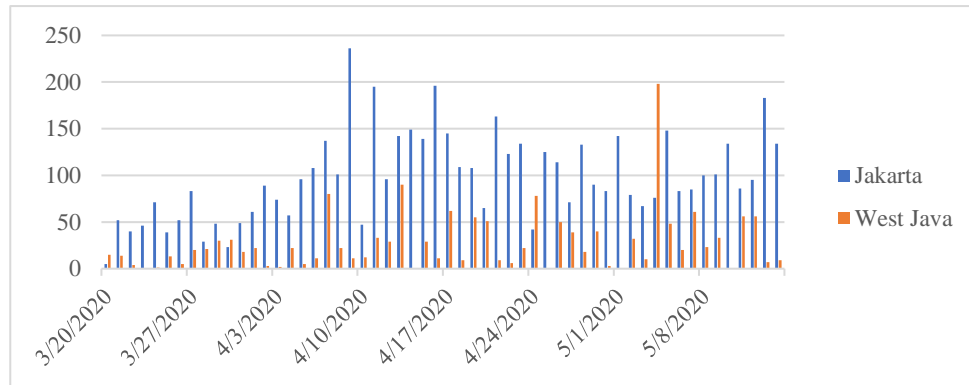


Figure 1. The daily new cases in Jakarta and West Java from March 20, 2020, to May 14, 2020

Large-Scale Social Restrictions (PSBB) have been implemented based on the Minister of Health Regulation Number 9 of 2020 [11]. PSSB was employed as a strategy to reduce the spread of COVID-19. PSBB is a restriction on activities in a province or city that are suspected of being infected with COVID-19. The restrictions contain limitations on the movement of people and/or goods, the closure of schools and jobs, restrictions on religious activities, activities in public places, transport, and access to and from the region [11]. The Minister of Health appoints the PSBB based on the proposal of the governor/regent/mayor or chairman of the government's COVID-19 Task Force using specified criteria. PSBB is effective when accompanied by large-scale rapid tests, contact tracking, strict isolation, and public compliance with PSBB.

Jakarta, as the capital city of Indonesia, has a high level of the social movement. The high social movements in Jakarta have caused many social contacts and movements of people that can increase the spread of COVID-19 [12]. The number of confirmed cases in Jakarta is the highest in Indonesia, reaching almost 35.5% of all confirmed cases in Indonesia on May 14, 2020. On May 14, 2020, the number of confirmed cases in Jakarta reached 5688 cases with 452 deaths [6]. Consequently, Jakarta becomes the epicenter of COVID-19 in Indonesia. To leveled the curve of COVID-19 cases, the provincial government has introduced the PSBB based on Regulation of Governor Number 33 of 2020. The Jakarta government's intervention was effectively implemented on April 10, 2020. In this first phase, PSBB was carried out for 14 days to April 23, 2020 [13]. The first phase of PSBB has many assessments, as evidenced by the number of new

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cases that are still increasing. PSBB becomes ineffective because many parties ignore the policy and the lack of socialization in the community [14]. The first phase can, therefore, be called the education phase [15].

The Jakarta provincial government extended the PSBB period until May 22, 2020, which was referred to as the second stage of the PSBB [16]. In addition, in the second phase, the Jakarta government will act directly against those who violate guidelines. Stricter regulations ensure that PSBB works effectively, so Jakarta may flatten the curve faster if PSBB is followed. Since the end of the first phase of PSBB, the spread of COVID-19 has tended to slow and the increase in new cases has stabilized. The government will further restrict visitors to Jakarta during Eid Al-Fitr to prevent the spread of COVID-19 [16]. The growth of cases in Jakarta from March 20, 2020, to May 14, 2020, is shown in Figure 2.

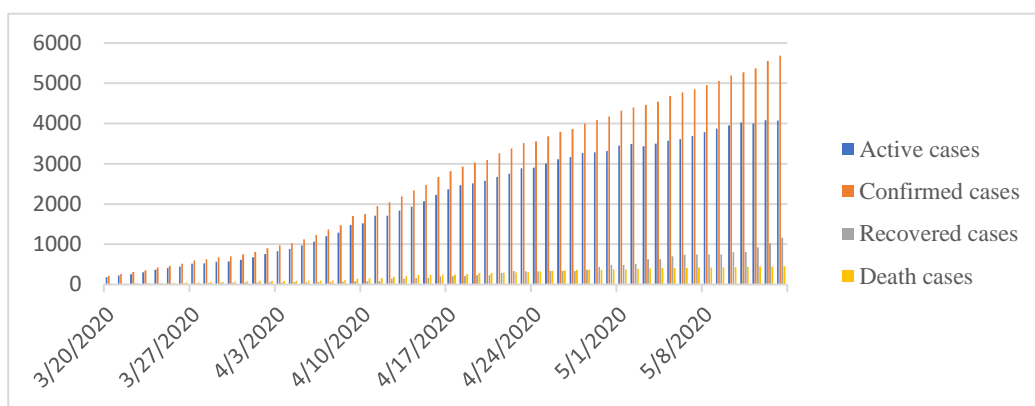


Figure 2. The cases in Jakarta from March 20, 2020, to May 14, 2020

West Java is the second province with the most cases of COVID-19 and the first province in which the first case was reported [6]. On May 14, 2020, the number of confirmed cases in West Java was 1565 cases with 99 deaths [17]. The government initially distributed into four clusters that were severely affected and caused COVID-19 cases in West Java. The first cluster came from the Sharia Business Seminar, in which 200 participants took part. 7 cases and 2 deaths were reported from this cluster. The second cluster came from annual synod churches in the Protestant Church of West Indonesia (GPIB), in which 600 participants attended, and 4 cases and 1 death were reported by this cluster. Both cases were in Bogor. The third cluster came from the Indonesian

Young Entrepreneurs Association (HIPMI) in West Java, Karawang, in which 400 participants participated, and 7 cases were reported from this cluster. The last cluster was a religious seminar in the Indonesian Bethel Church (GBI) in Lembang, in which fewer than 200 participants attended, reporting 3 cases and 1 death [18].

The cases in West Java continued to grow significantly. To smooth the COVID-19 curve in West Java, PSBB was implemented based on Governor's Decree No. 27 of 2020, which started from May 6, 2020, to May 19, 2020 [19]. Additionally, this intervention was previously carried out by the West Java government on April 15, 2020, in the cities of Bogor, Depok, and Bekasi. In addition, this intervention was also carried out in Bandung Raya on April 22, 2020. The governor of West Java reported that there were only 50 new cases on April 29, 2020, and 3 new cases in Bandung the day after. On May 2, 2020, there were no cases in West Java [19]. The number of active cases, confirmed cases, recovered cases, and death cases in West Java is shown in Figure 3.

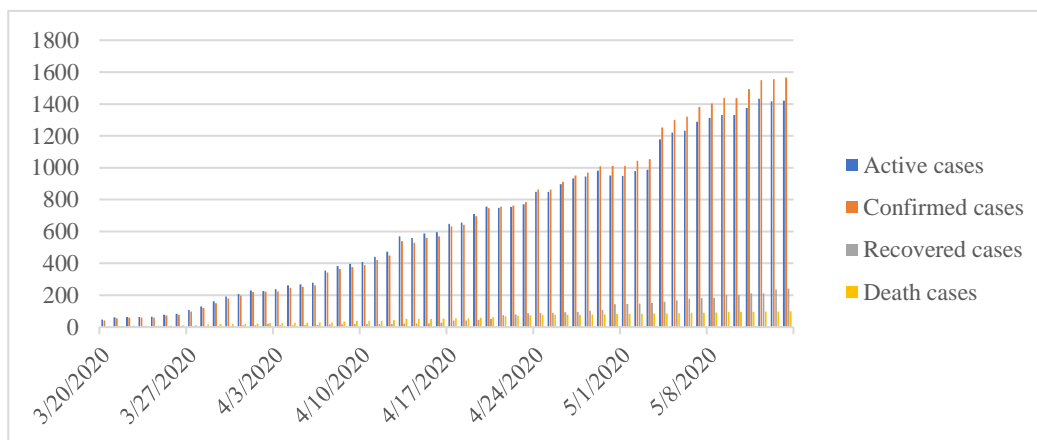


Figure 3. The cases in West Java from March 20, 2020, to May 14, 2020

Several studies have been done to predict the curve of COVID-19. Data from March 23, 2020, to April 14, 2020, was used in the first study. The result for the next 20 days, May 4, 2020, and this investigation showed that the number of cases would continue to peak. The cumulative movement of confirmed COVID19 cases is stable [20]. The other study concluded that the daily number of COVID-19 cases in Indonesia has the highest case of around 400 and will reach at least 12,000 people with COVID-19 in mid-June [21].

In order to answer basic questions about the current epidemic in Indonesia, we use a simple mathematical model. Without taking into account related factors such as ambient temperature, humidity, and so on. The hospital does not have enough capacity for COVID-19 patients, thus the rate of spreading strains is high. It is therefore vital for us to keep the rate of spread under our control if it has not been completely eliminated. In this study, we created a representation model for the number of COVID-19 cases using different neural network models, namely Neural Network Auto-Regressive, Single Layer Perceptron, Multi-Layer Perceptron, and Extreme Learning Machine. The confirmed cases may only be a subset of the total number of people infected without general testing. The unreported cases may exist. This study aims to find the most appropriate model to predict the number of active, confirmed, recovered, and death cases of COVID-19 in Jakarta and West Java as the regions with the most cases in Indonesia. We will use time series that are a sequence of time-oriented or chronological observations of the variables of interest [22]. By evaluating this simple model [23], it is hoped that the appropriate data patterns can be used to delineate the development of COVID-19 in Indonesia. Furthermore, the result later can be found as public information about future circumstances.

## **2. MATERIAL AND METHODS**

### **2.1 Material**

The data used in this study are historical data from COVID-19 active cases, confirmed cases, recovered cases, and death cases in two provinces, Jakarta, the capital city of Indonesia, and West Java. Active case data is the difference between the confirmed case and closed case, which contain recovered and death cases. Some forecasting methods that have been involved in this study are the several methods of neural networks, such as Multi-Layer Perceptron, Neural Network Autoregressive, and Extreme Learning Machine. The data to be utilized starting March 20, 2020, to May 14, 2020. The dataset was collected from the official website Task Force for the Acceleration of Handling COVID-19 which was formed by the Indonesian government.

## 2.2 Artificial Neural Network

ANN, proposed by McCulloch and Pits in 1943 [24], is an associate science system that works in the same method with biological neural networks that are believed to be highly accurate [25]. Three layers in ANN are the input layer, output layer, and hidden layer. There are activation functions in the output and hidden layer. Some commonly used activation functions are sigmoid and tangent hyperbolic. ANN is divided into two types, Feed Forward Neural Network (FFNN) and Recurrent Neural Network (RNN). FFNN is a network where connections between neurons in a layer do not form cycles, which means that the input only propagates forward from the input level to the output level.

## 2.3 Multi-Layer Perceptron

Later, [26] targeted machinability in perceptron for single-layer feed-forward networks. FFNN is the foremost well-liked neural network model to forecast the time-series model. It considers a single hidden layer with any neurons. A total of rehashes systems are fitted, each with random beginning weights that point arrived at the midpoint of once processing forecasts. The yields inform forecast for its future values, whereas the input neurons are the previous lagged observations. Hidden neurons with applicable non-linear transfer functions to process data delivered by the input neurons [27].

FFNN has an input layer, an output layer, and one or more hidden layers. Two types of FFNN are Single-Layer Perceptron (SLP) or perceptron with no hidden layer and Multi-Layer Perceptron (MLP) with one or more hidden layers. From a statistical point of view, its widely wide-spread approximation ability arises from the nonlinearities used within the neurons.

Every single connection between the input to neuron and neuron to the neuron is adjusted by weight. Also, every single neuron has an additional input that a relentless value of one is assumed. The weight that adjusts this input is termed bias [28].

All of the information propagates aboard the connections within the path from the input network to the output network, thus the term of the so-called feed-forward. Once the network is



running, each neuron in a hidden layer carries out the computation in Equation 1 on its inputs and conveys the result ( $O_c$ ) to the consecutive layer of the neurons.

$$O_c = h_{Hidden}(\sum_{p=1}^P i_{c,p} w_{c,p} + b_c) \text{ wherever } h_{Hidden}(x) = \frac{1}{1+e^{-x}}. \quad (1)$$

Equation 1 is an activation function of a neuron in a hidden layer, wherever  $O_c$  is that the output of the existing hidden layer neuron  $c$ ,  $P$  is the number of neurons among the earlier hidden layer or the network input,  $i_{c,p}$  is input to neuron  $c$  of the earlier hidden layer neuron  $p$ ,  $w_{c,p}$  is the weight that modifies the link from neuron  $p$  to neuron  $c$ , and  $b_c$  is the bias. In Equation 1,  $h_{Hidden}(x)$  is the sigmoid activation function of the neuron. To avoid saturation of the activation function, the data should be scaled. In the same way, to fittingly scaled data before training the weights and biases are initialized. Each neuron in the output layer carries out the computation in Equation 2 on its inputs and transmits the outcome ( $O_c$ ) to a network output.

$$O_c = h_{Output}(\sum_{p=1}^P i_{c,p} w_{c,p} + b_c) \text{ wherever } h_{Output}(x) = x. \quad (2)$$

Equation 2 is the activation function of accomplice neurons within the output layer, wherever  $O_c$  is the output of the existing output layer neuron  $c$ ,  $P$  is the number of neurons among the earlier hidden layer,  $i_{c,p}$  is the input to neuron  $c$  from the earlier hidden layer neuron  $p$ ,  $w_{c,p}$  is the weight that modifies the link from neuron  $p$  to neuron  $c$ , and  $b_c$  is the bias. Activation function will be used for  $h_{Output}(x)$  is a linear activation function.

Backpropagation (BP) is one of the most used algorithms for the training dataset. BP algorithm is a generalization of the delta rule, the so-called LMS algorithm, or generalized delta rule. It iteratively learns a set of weights and biases. Due to the BP algorithm, MLP may be prolonged to many layers. The execution time of the MLP turn increases in a row with the increment of the hidden layer, instead of it to improve accuracy.

## 2.4 Neural Network Auto-Regressive

A feed-forward neural network is fitted with a single hidden layer with extent neurons and slacked

estimations of  $y$  as inputs. The inputs are lags 1 to  $p$ , and lags  $m$  to MP where  $m = \text{freq}(y)$ . On the off chance that  $x_{reg}$  is given, its columns are additionally utilized as inputs. Though, if missing values in  $y$  or  $x_{reg}$  are detected the relating rows are discarded from the fit. A sum of reshapes networks is fitted, each with irregular beginning weights. Once computing forecasts, at that point, these are found the middle value of. The network is prepared for a one-step prediction. Recursively, multi-step predictions are processed.

The fitted model for data with a non-seasonal pattern is meant as NNAR  $(p,k)$ , where  $k$  is the number of hidden neurons. This is practically equivalent to an AR $(p)$  with non-linear functions. For data with seasonal pattern, the fitted model is indicated as NNAR  $(p,P,k)[m]$ , which is similar to ARIMA  $(p,0,0)(P,0,0)[m]$  with non-linear functions. While linear AR can model cycle, the modeled cycles are always symmetric. In contrast, the cyclic model in the NNAR has been modeled well and the irregularity of the cycles has been apprehended by the model. This is the one difference between AR and NNAR [29].

## 2.5 Extreme Learning Machine

ELM is a rapid learning algorithm for the single hidden layer of feed-forward neural networks proposed by Vapnik [30]. This method overcomes the debility of the previous neural network in the process of learning speed because ELM could be diminishing the training time and refining the performance of oversimplification [31]. The weights and biases of the hidden neurons are set randomly. Moreover, Moore-Penrose pseudoinverse [32] is used to determine the output weight under the criterion of the least-squares method.

The ELM network includes  $n$  neurons in the input layer,  $l$  neurons in the hidden layer, and  $m$  neurons in the output layer. For  $N$  random definite samples  $(x_i, t_i)$ , wherever  $x_i = [x_{i1}, x_{i2}, \dots, x_{in}]^T \in R^n$  and  $t_i = [t_{i1}, t_{i2}, \dots, t_{im}]^T \in R^m$ , more,  $(x_i, t_i) \in R^n \times R^m$  and  $i = 1, 2, \dots, N$ . Standard ELM with  $\tilde{N}$  hidden neurons and activation function  $f(x)$  are computationally model as

$$\sum_{i=1}^{\tilde{N}} \beta_i f_i(x_j) = \sum_{i=1}^{\tilde{N}} \beta_i f(a_i \cdot x_j + b_i) = t_j \text{ with } j = 1, 2, \dots, N, \quad (3)$$

where  $a_i = [a_{i1}, a_{i2}, \dots, a_{in}]^T$  is the weight vector that connecting the  $i^{th}$  hidden and input neurons,  $b_i$  is the bias of the  $i^{th}$  hidden neurons,  $\beta_i = [\beta_{i1}, \beta_{i2}, \dots, \beta_{im}]^T$  is the weight vector connecting the  $i^{th}$  hidden and output neurons. The activation function that used commonly is sigmoid, sine, and RBF. Equation 3 also known as  $H\beta = T$  where:

$$H(a_1, \dots, a_{\tilde{N}}, b_1, \dots, b_{\tilde{N}}, x_1, \dots, x_N) = \begin{bmatrix} f(a_{1 \cdot} x_1 + b_1) & \cdots & f(a_{\tilde{N} \cdot} x_1 + b_{\tilde{N}}) \\ \vdots & \ddots & \vdots \\ f(a_{1 \cdot} x_N + b_1) & \cdots & f(a_{\tilde{N} \cdot} x_N + b_{\tilde{N}}) \end{bmatrix}_{N \times \tilde{N}}, \beta = \begin{bmatrix} \beta_1^T \\ \vdots \\ \beta_{\tilde{N}}^T \end{bmatrix}_{\tilde{N} \times m}, T = \begin{bmatrix} t_1^T \\ \vdots \\ t_{\tilde{N}}^T \end{bmatrix}_{N \times m}.$$

$H$  is a matrix, the so-called hidden layer output of the network, which the  $i^{th}$  column represents the  $i^{th}$  hidden neuron output concerning inputs. As long as the amount of the hidden neurons is enough, the parameters of the network do not require to modify. ELM arbitrarily allocates to the input link weights  $a$  and hidden layer neuron biases  $b$ , when the training starts. In order to gain better performance, take  $\tilde{N} \ll N$ .

Once the hidden layer biases and input weights are stubborn according to the arbitrary allocation, the input samples might acquire the hidden layer output matrix. Accordingly, the training process of the ELM is broke down into answering linear equations  $H\beta = T$  least-squares solution.

$$\begin{aligned} & \|H(a_1, \dots, a_{\tilde{N}}, b_1, \dots, b_{\tilde{N}}, x_1, \dots, x_N)\hat{\beta} - T\| = \\ & \min_{\hat{\beta}} \|H(a_1, \dots, a_{\tilde{N}}, b_1, \dots, b_{\tilde{N}}, x_1, \dots, x_N)\hat{\beta} - T\|. \end{aligned} \quad (4)$$

The smallest norm least-squares solution of Equation 4 is

$$\hat{\beta} = H^\dagger T. \quad (5)$$

$H^\dagger$  in Equation 5 means Moore-Penrose pseudoinverse of the  $H$ . Generally, the optimal solution of  $\hat{\beta}$  covers some characteristics. The algorithm might obtain minimal training error, in order to  $\hat{\beta}$ . The optimal generalization ability of the model minimizes output weights. Because of  $\hat{\beta}$  is sole, the local optimal solution might prevent to produce.

## 2.6 Model Evaluation

Generally, the simplest model selection criteria that are often used are Mean Absolute Percentage Error (MAPE) because the value is in the form of a percentage so that it is appropriate to be accustomed to measure the accuracy of a model. Since the model has zero values, hence the Mean Absolute Error (MAE) will be utilized in this study. A model becomes the best model if it has a small MAE value. The MAE will be used with the subsequent equation:

$$MAE = \frac{1}{n} \sum_{t=1}^n |X_t - \widehat{X}_t| \times 100\%, \quad (6)$$

where  $n$  is the number of observations,  $X_t$  is the observed value,  $\bar{X}_t$  is the mean of the observed value, and  $\widehat{X}_t$  is the predicted value.

## 3. RESULTS AND DISCUSSION

In this study, the analysis was done by using software open source R with packages `nnfor`. The neural network is a method that the assumption is not needed. Thus, model identification, such as stationery check was not being done. For both Jakarta and West Java, the methods involved in this study are NNAR, MLP with one hidden layer and two hidden layers, and ELM. These methods will generate the MAE value for the next ten-day forecasts for the active, confirmed, recovered, and deaths case, also the new daily cases in both provinces. These methods are automatically modeled by software and the best model of each method is used to forecasting the values of the further periods. In this study, forecasts are done for the next ten days.

NNAR method produced the best model from averages 20 networks and each network that has 4 weights is a 1-1-1 network. This method is run automatically to seek the best order for both NN and AR. The best model gained is NNAR (1,1). The output from this method is a linear output unit with  $\sigma^2$  estimated as 2110, 2214, 774.1, 73.53, 1021, 968.1, 42.69, and 3.46 for each active, confirmed, recovered, death cases in Jakarta and West Java. For the daily new cases in Jakarta, the best model is NNAR (2,2) is a 2-2-1 network from averages 20 networks with 9 weights and  $\sigma^2$  estimated as 1228. However, for the daily new cases in West Java, the best model is the same as

the other cases, namely NNAR (1,1) or a 1-1-1 network that has  $\sigma^2$  of 1019 and generated from 20 networks with 4 weights.

Moreover, the MLP model was conducted. There are two types of this method, which consist of one hidden layer and two hidden layers. For the model with a single hidden layer, the number of neurons in the hidden layer is automatically checked and acquired 5 hidden neurons. Another model, with two hidden layers, used 10 hidden neurons in each layer with 20 repetitions. These modeled in differencing. It will include lag 1 always so the selection algorithm decides that nothing should stay in the network. Univariate lags (1,2,3,4) are retained in both provinces for all the cases. The median operator is being combined to forecast and the Mean Square Error (MSE) for each case in Jakarta and West Java with both MLP models are presented in Table 1.

Table 1. MSE values of MLP models

Model	Jakarta					West Java				
	A	C	R	D	DN	A	C	R	D	DN
MLP	191.05	254.43	269.9	10.1	287.68	227.85	194.06	14.4	0.92	245.83
MLP (10,10)	3.21	19.78	32.94	0.72	19.87	36.29	29.05	2.19	0.06	19.78

\*A: active cases, C: confirmed cases, R: recovered cases, D: death cases, DN: daily new cases

Lastly, the ELM method was involved in this study. As well as the MLP model, the ELM model fit with 20 repetitions. Besides, 49 hidden neurons for active, confirmed, recovered, and death cases in Jakarta and West Java, also, 50 hidden neurons for daily new cases in Jakarta and West Java are used. For estimation of the output weight, then, the lasso is utilized. Since forecast combined using the median operator, MSE values of the active, confirmed, recovered, death, and daily new cases in both Jakarta and West Java are 2547.02, 2009.82, 1199.40, 3.76, 1862.27, 1114.42, 1081.15, 52.89, 83.76, 1075.69. Those models above have been training and the evaluation of those models is carried out of the testing process for a ten-day forecast. The MAE values of those models are mentioned in Table 2.

Table 2. MAE values of the models

Model	Jakarta					West Java				
	A	C	R	D	DN	A	C	R	D	DN
NNAR	35.79	35.53	19.79	6.23	27.31	20.75	20.60	4.15	1.48	21.53
MLP (5)	9.69	11.25	10.38	2.38	12.48	10.80	9.28	2.23	0.69	10.70
MLP (10,10)	0.98	1.90	2.71	0.42	1.55	2.99	2.82	0.85	0.10	2.47
ELM	38.65	35.90	26.46	33.89	34.28	22.42	22.05	4.81	1.58	22.03

\*A: active cases, C: confirmed cases, R: recovered cases, D: death cases, DN: daily new cases

As we can see in Table 2, the lowest MAE value of the whole cases in Jakarta and West Java are obtained by the MLP (10,10) model. Furthermore, the models with the lowest MAE value are applied to forecast the future number of each case, including active cases, confirmed cases, recovered cases, death cases, and daily new cases caused by COVID-19 in Jakarta and West Java. Multi-step ahead forecasting was applied to these models and the results of the next ten days forecasting are reported in Table 3.

Table 3. Forecasting results of the best model

Date	Jakarta					West Java				
	A	C	R	D	DN	A	C	R	D	DN
May 15, 2020	4095	5960	1317	462	214	1227	1580	251	100	16
May 16, 2020	4129	6065	1416	482	127	1284	1655	248	105	79
May 17, 2020	4163	6216	1589	490	148	1325	1660	243	110	17
May 18, 2020	4214	6317	1694	497	134	1323	1708	244	110	26
May 19, 2020	4235	6441	1823	506	91	1343	1725	239	109	29
May 20, 2020	4282	6585	1951	508	53	1373	1770	255	112	40
May 21, 2020	4322	6675	2046	517	83	1406	1781	254	117	8
May 22, 2020	4387	6836	2204	523	71	1416	1814	260	118	19
May 23, 2020	4431	6938	2345	533	73	1436	1836	263	121	24
May 24, 2020	4472	7104	2491	544	71	1458	1875	255	123	15

\*A: active cases, C: confirmed cases, R: recovered cases, D: death cases, DN: daily new cases

In Table 3, we can see that the number of daily new cases in Jakarta and West Java for the next ten-day fluctuates. Nonetheless, the number of other cases are deliberately increasing. The actual data and the forecasting results are plotted and the plot of these displayed in Figure 4.

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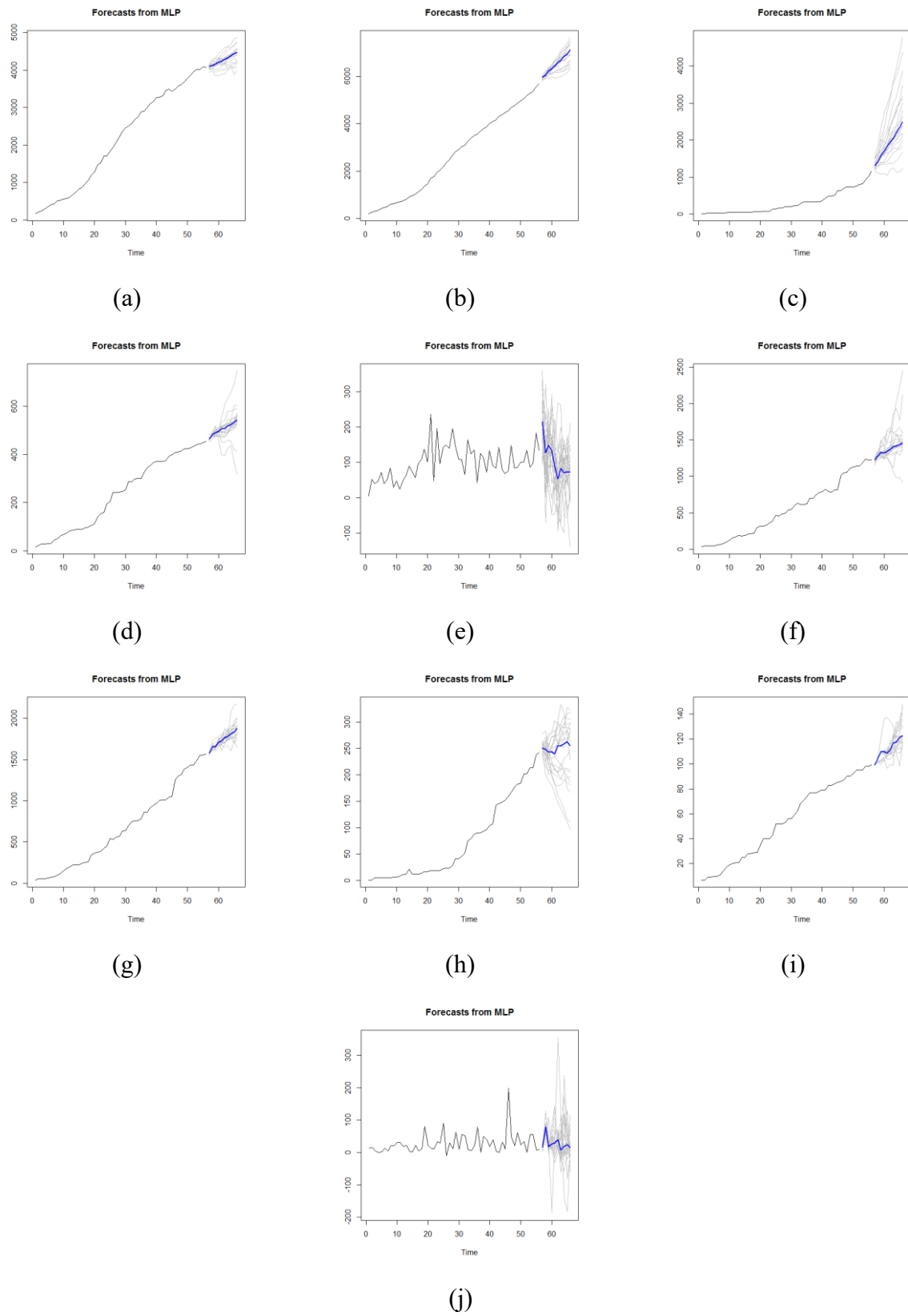


Figure 4. The plot of forecasting each case in both Jakarta and West Java with the best model.

(a) Jakarta's active cases, (b) Jakarta's confirmed cases, (c) Jakarta's recovered cases, (d) Jakarta's death cases, (e) Jakarta's daily new cases, (f) West Java' active cases, (g) West Java' confirmed cases, (h) West Java' recovered cases, (i) West Java' death cases, (j) West Java' daily new cases.

#### 4. CONCLUSIONS

The prediction of future values of daily new cases in Jakarta and West Java shows a downward trend, in other words, these cases are slowly declining. In addition, we can conclude that government intervention known as PSBB has been shown to be effective in reducing the number of daily new cases of COVID-19. In this study, we assumed that these interventions have been well implemented by the community while these measures were established. By design, there are no other factors that affect data patterns.

Figure 4(a) shows that active cases in Jakarta are still an upward trend even though the daily new cases as presented in Figure 4(e) is diminishing. As well as Jakarta, the daily new cases in West Java, mentioned in Figure 4(j), show a decline though it is still varying. Nevertheless, the active cases in West Java which are mentioned in Figure 4(f), indicate a more flatten curve than Jakarta. In spite of this, the community and government have to be careful with this pandemic, as the number of daily new cases is still changeable despite the fact it shows a downward trend.

Neural networks could be used as an alternative model to adapt to the unknown fluctuation. Based on these models, as mentioned earlier, we can conclude that the MLP (10,10) model works best for all models because this model performs better than the others. The MAE values of the MLP (10.10) model and the other models differ considerably.

The best model can be utilized to predict the number of individual cases in Jakarta and West Java if only historical data is taken into account without considering other factors that affect the number of these cases. In this study, it was assumed that all factors affecting the number of active cases followed the pattern previously shown in historical data, so the confirmed, recovered, fatal, and new cases follow the same pattern. Furthermore, the guidelines implemented by the local government to decrease the number of confirmed cases with COVID-19 also affect the outcome



of the forecasts. Consequently, further research is needed to find out which factors influence the forecast value of the number of cases then the forecast results obtained are more accurate.

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### CONFLICT OF INTERESTS

The authors declare that there is no conflict of interests.

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